

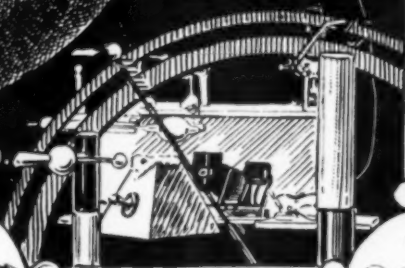
VOL. 3. No. 4. OCTOBER, 1898.

THE AMERICAN

X-RAY JOURNAL

A MONTHLY
DEVOTED
TO THE
PRACTICAL
APPLICATION
OF THE
NEW SCIENCE
AND TO THE
PHYSICAL
IMPROVEMENT
OF MAN.

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WM. W. GRAVES, M.D., }

C. C. SPINK, BUSINESS MANAGER.

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LOCALIZATION AND THE X-RAYS.

The application of the x-rays to medicine and surgery has encountered many checks in its progress to the important results at first prophesied. The responsibility for these reverses lies almost entirely with the surgeons who have overlooked the fact that they are dealing with a shadow which depends for its appearance and situation upon the three essential adjuncts of every shadow—the source of the light, the object and the plane on which it is projected.

In a large x-ray practice only a small

percentage of the cases are those requiring the localization of foreign bodies, but when the occasion arises there should be available a method which will give a quick and accurate result. Many have taken two skiagraphs at right angles and after an examination of them, have entered the operating room with the idea that they knew exactly where the foreign body was situated only to hunt for a long time and perhaps find it finally at some distance from the place where they thought it should have been.

The disrepute into which the x-rays have been thrown by such experiences —altogether too common—might have been avoided if the operators had remembered to apply their geometry to interpret the shadow. While there have been many articles written on the subject of localization by means of the x-rays the author has not been able to find but very few which have been entirely correct from a geometrical standpoint and no one which while mathematically correct could be applied without expense with the apparatus at hand. To be efficiently equipped it is not necessary as some instrument makers would have you believe, to purchase apparatus as expensive as our generator, although perhaps such an instrument may economize time to a certain extent.

Thinking there might be some who would be interested to know what has been used with success, the following three methods have been briefly set

forth. The first method requires no outlay for apparatus but is the least accurate of the three. With care, however, the error should not exceed the distance of a centimeter, which will be sufficiently accurate for many of the cases. The second and third methods make use of the same principle but with simple apparatus which increases the accuracy and ease of application.

FIRST METHOD.

The plate is placed on the table and the patient upon it in such a way that the region in which the bullet is thought to be is over the plate. The positions of two adjacent edges of the plate are marked on the surface of the skin. The relation of plate and body now fixed must not be disturbed until the exposure has been made. The tube is placed above the part in such a way that a perpendicular from it will fall on the plate nearer to one side.

The plate, patient and tube being placed in position the radiograph is taken. Before anything is disturbed a perpendicular is let fall from the centre of the tube to the surface of the patient, and the point there marked with indelible ink. The subject is then removed without disturbing either the plate or the tube and this perpendicular is continued to the wrapping of the negative and there marked with a pencil. This point is pricked through the film below with a pin, and the perpendicular distance from the focus of the tube to the plate is carefully measured. It is best to develop the plate at once so that if the suspected positions of the projectile is far from correct an error in placing the second plate may not be made.

After the development of the first plate and while fixing, a fresh negative is placed on the table and the patient upon it. By using the marks on the skin as guides the plate and patient may be made to occupy the same relative position that they occupied when the first

exposure was made. The position of the tube relative to the plate and subject is changed, care being taken that it is not placed in the perpendicular plane which contains the projectile and the point occupied by the focus of the tube when the first exposure was taken. If, however, the focus should be placed in this plane the problem may still be solved by a slight modification of the method given.

The second skiagraph is taken, and the measurement and marks determined as before. After development as soon as the plates are dry, prints are taken from them. It has been found convenient to use a printing frame and paper larger than the negatives so that its edges which are to be used for orientation may be clearly defined on the prints. If one desires to get the results in the shortest possible time, the following method may be used which is more expeditious than drying with alcohol; a piece of "Velox" or of bromide paper is printed directly from the wet plate after having washed off the fixing solution. The paper is wet and smoothed down on the film surface, the glass back is wiped dry and the correct exposure made. In a few moments the print may be developed and made ready for use. The plate will not be injured in the least by the process.

Having obtained the two prints, they are placed with their reference edges together, the centre of the shadow of the projectile, and the point which indicates the foot of the tube, are pricked through both prints. The under print is then taken and a needle is thrust through the corresponding points shown on it. On the back of this second print will appear four pin holes occupying the same relative positions to each other that the shadows of the projectile and the projections of the foci of the two sources of the x-rays have on the plane of the photographic plate. Now these

four pin holes are joined by two intersecting lines and the point of intersection will be perpendicularly below the place occupied by the projectile.

In Figure 1, S and S' represent the position of the shadows when the rays originate from the points F and F', and A and C are the points where the perpendiculars let fall from F and F' meet the plane of the photographic plate. P, the position of the projectile, will be seen to be directly over the intersection of the lines joining the points A S and C S'. The distance above this plane or

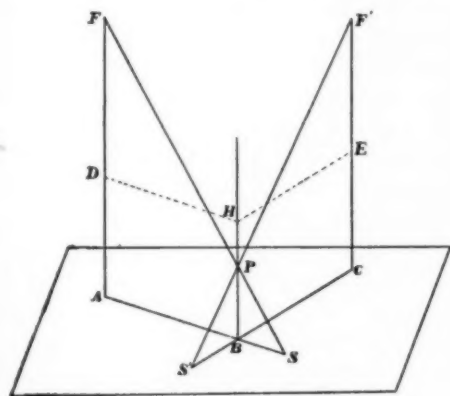


Fig. 1.

the length of the line P B may be readily obtained from the right angled triangles F' C S' and P B S' in which F' C has been measured and the lines S' B and S' C can be measured directly from the back the print, P B will be equal to F' C times S' B divided by S' C. It is best to obtain the value of P B also from the triangles F A S and P B S in order that an error in the work may be apparent at once by a difference in results which should be the same or nearly the same. It will require only a very few minutes with the print to obtain the position of the projectile with reference to these four points in the

plane of the negatives. It now remains to apply this knowledge to the patient. The points where the perpendiculars met the patient have been marked with indelible ink and with these as centres and with radii equal to A B and C B, arcs are described. Their intersection will be on the perpendicular P B at H directly over the projectile. Knowing the thickness of the body at this point the distance down to the object sought may be found by subtraction. The point H may also be found by laying the print on the surface film down so that the points A and C will be over the points D and E, marked there when the skiagraphs were taken. Then H will be directly under the point B on the print.

The accuracy of this method depends upon the operator's ability to place the patient and the plate in the same relative position for the second exposure as that occupied during the first. Rotation of the affected part should be carefully looked for and avoided. It is very easy to overlook this and it may introduce a large error. If the focus of the tube is determined to be three centimeters from its correct position it will, provided the other factors are correct, place the bullet but a centimeter from its real position. So it is seen that this factor is not quite as important as the first mentioned. The point directly under the focus has been found by holding a bicycle ball against the glass as near perpendicularly below the desired place as could be determined by the eye, in two positions at right angles to each other and then dropping it. When it struck the plate several times in the same place this place was marked as the foot of the perpendicular required. The altitude was measured at the side of the tube.

This method has been used several times at the Lionel Laboratory of the Washington D. C. Emergency Hospital

and has been found to give quite accurate results in every case.

SECOND METHOD.

In this method we undertake to correct the inaccuracies of the above by making use of some simple apparatus. The same principle is used as a foundation.

First in order to have the plates fixed more exactly with reference to the patient and to each other the following device is used: Two strips of wood are

tient the plates may be changed and yet their images be exactly oriented through the fixed points of reference.

Secondly, two adjustable wooden arms having at their extremities a piece of metal with a hole in the centre are placed upon the surface of the patient opposite the plate. These arms are fastened to a frame which is screwed to the table but which may be removed and replaced again without disturbing the adjustment of the arms.

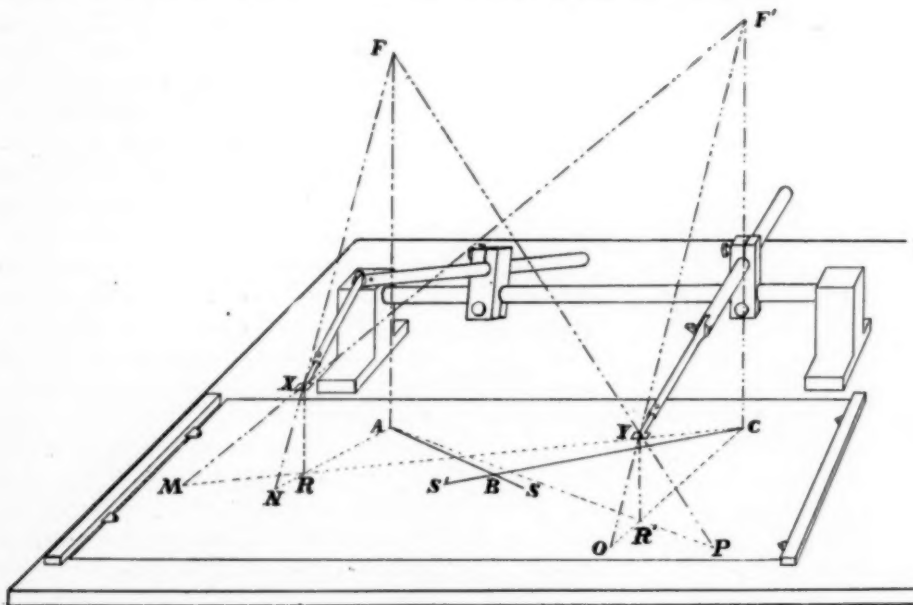


Fig. 2.

screwed to the table at a distance from each other equal to the length of the plate to be used. From the inner side of each strip two pieces of metal, having a small hole in them, project. These pieces of metal placed as near as possible to the negatives will cast their shadows on them and appearing on all the skiagraphs will serve as points for orientation. Resting on these strips is a thin board and the patient is placed on this. Thus without moving the pa-

Now having the patient fixed immovable over the plate and under these reference arms, the tube is placed in position above and an exposure made. The tube is moved to a new position and with a fresh plate a second skiagraph is taken. The position of the holes in the discs at the ends of the reference arms are marked on the skin with indelible ink. Then the frame holding these arms is unscrewed from the table to allow the patient to be re-

moved, after which it is replaced. A plumb line is let fall from the centre of each hole in the reference discs to the envelope of the last negative which has not been moved, and the points marked through the film with a needle. The exact altitude of these discs is also measured.

These measurements complete the necessary data and it remains simply to make the computations. The print from the last negative is taken first and from it the perpendicular distances to the focus of each tube and the point where these perpendicular lines meet the plane of the negative are to be found first.

Figure 2 represents the back of this print with the construction lines to be used, and the reference discs above it in the position they occupied when the skiagraph was taken. On the print we have the four points M, N, O, P, which represent the positions of the shadows of the two reference discs, M and O being cast by the tube when its focus is at F', and N and P when it is at F. Straight lines from M and O through the points R and R' will meet directly below F' and thus give a means of locating this point. The altitude of the focus may now be computed from the triangles F' C M and X R M, three of the elements, X R, M R and M' C being now known. After finding the altitude of the second focus in the same manner the position of the projectile is found as in the first method.

In applying this method to the patient the points under the reference discs are used to measure from instead of the points D and E (Fig. 1) made use of before. It is true that geometrically two reference points alone cannot determine a third point, (P Fig. 1), in space, but that is not just what is done here. The plane, containing these two reference points X and Y, from which we measure the depth to the bullet is

considered to be parallel to the table and to be a known factor in the problem. Occasionally it will coincide with the surface of the body at the point from which we wish to measure down to the bullet. In which case the problem is simple and may be very accurately applied. But if—as is most often the case—the points X and Y are at different distances above the table, this plane is not parallel and if the determination is to be applied to a limb or to a portion of the body which is much curved, the application will be subject to some error. This error will be one of depth, not of location in any other direction and it may be entirely eliminated by making use of M. Contremoulins' "operating compass" as explained in the following or third division of this paper.

THIRD METHOD.

The method of MM Remy and Contremoulins (*Comptes Rendus* Nov. 22, 1897,) has the great advantage over all other systems with which the author is acquainted, in that it may be taken to the operating room and a needle attached to a sterilized compass frame guides the surgeon's knife directly to the object sought. This arrangement may be easily used in connection with the second method given above by adding a third reference disc. This disc need not necessarily cast its shadow on the plate nor have its altitude determined. Its position should, however, be marked on the skin. The compass is adjusted for the operating room by placing its three feet in the centres of these reference discs and placing the needle so that it will lead along the most desirable path to the object sought. The position of the bullet in space is determined for this purpose by placing the diagram of the projections of the bullet and the reference discs in the place beneath these discs which the plate occupied when the first skiagraph was taken, and then

measuring the computed distance from the projection of the object to the object itself.

It is necessary of course that these three discs should not be in the same straight line. But aside from this they may be placed where most convenient, preferably some distance from each other and over places where the bone is subcutaneous or as near so as can be found in the vicinity. This is desirable in order that the compass may be as firmly placed as possible.

The "operation compass" of M. Contremoulins is described in substance as follows:

This compass consists of a frame and four branches, three of which have double joints allowing adjustment in any direction. These act as feet to hold the frame of the compass in a fixed position. In our case they are adjusted to the three reference discs from above and thus may be placed upon the three points which have been marked upon the skin of the patient.

The fourth branch, which is movable in all directions, carries a guide through which slides a blunt needle. This branch is fixed in the proper position and the needle is made to slide until it touches the point in space which we have found that the bullet occupied during the exposures with reference to the reference discs, and by means of a screw ring one fixes upon the needle the point at which it stops in the guide when its extremity is in contact with place the bullet occupied.

Now the "operating compass" being adjusted it only remains to transfer it to the patient and the surgeon guided by the needle may begin his work. In order to do this the needle is first removed, and the compass feet are placed on the register points already marked on the skin. The needle is placed in its guide, and by sliding indicates the direction in which the ball is to be found. The

depth is indicated by the distance between the guide and the ring which was screwed upon the needle.

The branch holding the needle, being adjustable at will, may be so placed that the surest, safest and shortest way to the object sought may be selected. Whatever the path selected, the needle will always indicate the exact direction and depth, and during the operation the

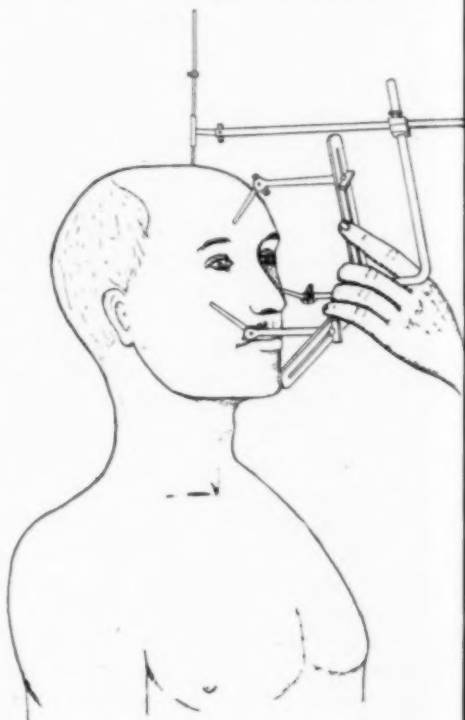


Fig. 3.

needle will constantly indicate through the distance of the ring from the slide the exact distance at which the operator is from the projectile. The compass held in position on the head is shown in Figure 3.

M. Contremoulins claims that his method when applied with his complete and expensive apparatus will find the centre of a projectile in the brain with

an error not greater than a half a millimeter. If his "operation compass" is used in the manner just described with the same care an equal degree of accuracy ought to be obtained, although a half a millimeter is a very small error. This method has the further advantage of not requiring his expensive pieces of auxiliary apparatus.

WALTER H. MERRILL.

LUPUS TREATED BY X-RAYS.

BY J. RUDIS-JICINSKY, A. M., M. D.

We all read about the risk of setting up x-ray dermatitis, etc., and know, that the powerful x-ray has an influence upon tissue causing inflammation of the conjunctivae, lips and of the skin of the face. This has been recorded by more than one experimenter as the result of exposure to the Roentgen ray. This being the case we have in the x-ray the best means for producing irritation for an artificial inflammation and converting unhealthy ulceration into open and healthy granulation, proving that the x-ray may have in some cases an actual therapeutic value.

After a few tests in application of the x-ray in cases of lupus, in which most favorable results were obtained, the writer began to treat all such affections with x-ray. This was done upon the basis of actual personal experiments and encouragement given by the splendid results obtained by Kummel, Gochl, Schiff, Mracek, Albers and Schoenberg.

J. D. had for years a lupus erythematosus on the left leg, characterized by the appearance of pinkish patches covered with yellowish adherent scales. It began "as a pin head, slightly elevated spot, later more spots were observed, forming regular patch, elevated, and distinctly outlined against the healthy skin, loss of tissue and subsequent cicatricial formation. Sometimes the

lupus was quite amenable to treatment, but reappeared again near the old scars. I tried at last the x-ray.

Having tested the tube with the screen to see that it was working at its best and working with 8-inch coil, I tried to obtain good result with comparatively short exposures. Healthy tissue was oiled (Olive oil) and protected with Staniol and the tube removed about 15 to 18 inches, to avoid the danger of too intense action of the rays. At the first trace of brownish coloration of the skin, the treatment must be stopped at once. It must be certainly systematically employed to secure a complete cure. After the first application of the x-ray, nodules previously invisible, become visible, finally fall off and infiltrated lymphatic glands diminished in number. Later the unhealthy ulceration under the action of the rays, producing a general inflammatory reaction (Schiff), were changed to open and healthy granulation. This was six months ago. The patient is now completely cured.

F. C. had for months lupus vulgaris on the right side of his face. In the beginning there was an appearance of yellowish, deep papules. They gradually extended and appeared in the form of yellowish tubercles and apple-jelly like nodules, with abundant secretion forming crust, irregular and unhealthy ulceration. This facial lupus was exposed to the x-ray and also in this case, there can be no doubt about the curative action and influence of the x-ray. Gochl explains the action of the x-rays on lupus by the fact that they determine a non-infectious inflammation, which extends into the subcutaneous tissue (cellular) and destroys the tubercle bacilli. Certainly it yet remains for us to determine whether the powerful x-rays of today possess a germicidal action. Its employment in cases of lupus is worthy of extended trial.

Crete, Neb., Sept. 6, 1898.

**BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
BRISTOL, 1898.**

Abstract of Presidential Address* By Sir William Crookes, F. R. S., V. P. C. S., President.

*Owing to the exigencies of space, only that portion of the Address that touches directly or indirectly upon electrical science is given.

For the third time in its history the British Association meets in your City of Bristol. The first meeting was held under the presidency of the Marquis of Lansdowne, in 1836; the second under the presidency of Sir John Hawkshaw, in 1875. Formerly, the President unrolled to the meeting a panorama of the year's progress in physical and biological sciences. To-day, the President usually restricts himself to specialties connected with his own work, or deals with questions which, for the time, was uppermost. To be President of the British Association is undoubtedly a great honor. It is also a great opportunity and a great responsibility; for I know that, on the wings of the press, my words, be they worthy or not, will be carried to all points of the compass. I propose, first, to deal with the important question of the supply of bread to the inhabitants of these islands, then to touch on subjects to which my life work has been more or less devoted. I shall not attempt any general survey of the sciences; these, so far as the progress in them demands attention, will be more fitly brought before you in the different sections, either in the addresses of the presidents or in communications from members.

Some years ago Mr. Stanley Jevons uttered a note of warning as to the near exhaustion of our British coal fields. But the exhaustion of the world's stock of fixed nitrogen is a matter of far greater importance. It means not only a catastrophe little short of starvation for the wheat eaters, but indirectly, scarcity for those who exist on inferior

grains, together with a lower standard of living for meat eaters, scarcity of mutton and beef, and even the extinction of gun-powder.

There is a gleam of light amid this darkness of despondency. In its free state nitrogen is one of the most abundant and pervading bodies on the face of the earth. Every square yard of the earth's surface has nitrogen gas pressing down on it to the extent of about seven tons—but this is in the free state, and wheat demands it fixed. To convey this idea in an object-lesson, I may tell you that, previous to its destruction by fire, Colston Hall, measuring 146 feet by 80 feet by 70 feet, contained 27 tons' weight of nitrogen in its atmosphere; it also contained one-third of a ton of argon. In the free gaseous state this nitrogen is worthless; combined in the form of nitrate of soda it would be worth about £2,000.

For years past attempts have been made to effect the fixation of atmospheric nitrogen, and some of the processes have met with sufficient partial success to warrant experimentalists in pushing their trials still further; but I think I am right in saying that no process has yet been brought to the notice of scientific or commercial men which can be considered successful either as regards cost or yield of product. It is possible, by several methods, to fix a certain amount of atmospheric nitrogen; but to the best of my knowledge no process has hitherto converted more than a small amount, and this at a cost largely in excess of the present market value of fixed nitrogen.

The fixation of atmospheric nitrogen, therefore, is one of the great discoveries awaiting the ingenuity of chemists. It is certainly deeply important with its practical bearings on the future welfare and happiness of the civilized races of mankind. This unfulfilled problem, which so far has eluded the strenuous

attempts of those who have tried to wrest the secret from nature, differs materially from other chemical discoveries which are in the air, so to speak, but are not yet matured. The fixation of nitrogen is vital to the progress of civilized humanity. Other discoveries minister to our increased intellectual comfort, luxury, or convenience; they serve to make life easier, to hasten the acquisition of wealth, or to save time, health, or worry. The fixation of nitrogen is a question of the not far distant future. Unless we can class it among certainties to come, the great Caucasian race will cease to be foremost in the world, and will be squeezed out of existence by races to whom wheaten bread is not the staff of life.

Let me see if it is not possible even now to solve the momentous problem. As far back as 1892 I exhibited, at one of the soirees of the Royal Society, an experiment on "The Flame of Burning Nitrogen." I showed that nitrogen is a combustible gas, and the reason why when once ignited the flame does not spread through the atmosphere and deluge the world in a sea of nitric acid, is that its igniting point is higher than the temperature of its flame—not, therefore, hot enough to set fire to the adjacent mixture. But by passing a strong induction current between terminals the air takes fire, and continues to burn with a powerful flame, producing nitrous and nitric acids. This inconsiderable experiment may not unlikely lead to the development of a mighty industry destined to solve the great food problem. With the object of burning out nitrogen from air so as to leave argon behind, Lord Rayleigh fitted up apparatus for performing the operation on a larger scale, and succeeded in effecting the union of 29.4 grammes of mixed nitrogen and oxygen at an expenditure of one horse-power. Following these figures it would require one Board of Trade

unit to form 74 grammes of nitrate of soda, and, therefore, 14,000 units to form one ton. To generate electricity in the ordinary way with steam engines and dynamos, it is now possible with a steady load night and day, and engines working at maximum efficiency, to produce current at a cost of one-third of a penny per Board of Trade unit. At this rate one ton of nitrate of soda would cost £26. But electricity from coal and steam engines is too costly for large industrial purposes; at Niagara, where water-power is used, electricity can be sold at a profit for one-seventeenth of a penny per Board of Trade unit. At this rate nitrate of soda would cost not more than £5 per ton. But the limit of cost is not yet reached, and it must be remembered that the initial data are derived from small scale experiments, in which the object was not economy, but rather to demonstrate the practicability of the combustion method, and to utilize it for isolating argon. Even now electric nitrate at £5 a ton compares favorably with Chili nitrate at £7 10s. a ton; and all experience shows that when the road has been pointed out by a small laboratory experiment, the industrial operations that may follow are always conducted at a cost considerably lower than could be anticipated from the laboratory figures.

Before we decide that electric nitrate is a commercial possibility, a final question must be mooted. We are dealing with wholesale figures, and must take care that we are not simply shifting difficulties a little further back without really diminishing them. We start with a shortage of wheat, and the natural remedy is to put more land under cultivation. As the land cannot be stretched, and there is so much of it and no more, the object is to render the available area more productive by a dressing with nitrate of soda. But nitrate of soda is limited in quantity, and will soon be ex-

hausted. Human ingenuity can contend even with these apparently hopeless difficulties. Nitrate can be produced artificially by the combustion of the atmosphere. Here we come to finality in one direction; our stores are inexhaustible. But how about electricity? Can we generate enough energy to produce 12,000,000 tons of nitrate of soda annually? A preliminary calculation shows that there need be no fear on that score. Niagara alone is capable of supplying the required electric energy without much lessening its mighty flow.

The future can take care of itself. The artificial production of nitrate is clearly within view, and by its aid the land devoted to wheat can be brought up to the 30 bushels per acre standard. In days to come, when the demand may again overtake supply, we may safely leave our successors to grapple with the stupendous food problem.

And, in the next generation, instead of trusting mainly to food stuffs which flourish in temperate climates, we probably shall trust more and more to the exuberant food stuffs of the tropics, where, instead of one yearly sober harvest, jeopardized by any shrinkage of the scanty days of summer weather, or of the few steady inches of rainfall, nature annually supplies heat and water enough to ripen two or three successive crops of food stuffs in extraordinary abundance. To mention one plant alone, Humboldt—from what precise statistics I know not—computed that, acre for acre, the food productiveness of the banana is 133 times that of wheat—the unripe banana, before its starch is converted into sugar, is said to make excellent bread.

Considerations like these must, in the end, determine the range and avenues of commerce, perhaps the fate of continents. We must develop and guide Nature's latent energies, we must utilize her inmost workshops, we must call into

commercial existence Central Africa and Brazil to redress the balance of Odessa and Chicago.

Having kept you for the last half hour rigorously chained to earth, disclosing dreary possibilities, it will be a relief to soar to the heights of pure science, and to discuss a point or two touching its latest achievements and aspirations. The low temperature researches which bring such renown to Prof. Dewar and to his laboratory in the Royal Institution have been crowned during the present year by the conquest of one of Nature's most defiant strongholds. On May 10th last, Prof. Dewar wrote to me these simple but victorious words: "This evening I have succeeded in liquefying both hydrogen and helium. The second stage of low temperature work has begun." Static hydrogen boils at a temperature of 238 deg. C. at ordinary pressure, and at 250 deg. C. in a vacuum, thus enabling us to get within 23 deg. C. of absolute zero. The density of liquid hydrogen is only 1-14th that of water, yet in spite of such a low density it collects well, drops easily, and has a well-defined meniscus. With proper isolation it will be as easy to manipulate liquid hydrogen as liquid air.

The investigation of the properties of bodies brought near the absolute zero of temperature is certain to give results of extraordinary importance. Already platinum resistance thermometers are becoming useless, as the temperature of boiling hydrogen is but a few degrees from the point where the resistance of platinum would be practically nothing, or the conductivity infinite.

Several years ago I pondered on the constitution of matter in what I ventured to call the fourth state. I endeavored to probe the tormenting mystery of the atom. What is the atom? Is a single atom in space solid, liquid or gaseous? Each of these states involves ideas which can only pertain to vast collec-

tions of atoms. Whether, like Newton, we try to visualize an atom as a hard, spherical body, or, with Boscovitch and Faraday, to regard it as a centre of force, or accept the vortex atom theory of Lord Kelvin—an isolated atom is an unknown entity difficult to conceive. The properties of matter—solid, liquid, gaseous—are due to molecules in a state of motion. Therefore, matter, as we know it, involves essentially a mode of motion; and the atom itself—intangible, invisible, and inconceivable—is its material basis, and may, indeed, be styled the only true *matter*. The space involved in the motions of atoms has no more pretension to be called matter than the sphere of influence of a body of riflemen—the sphere filled with flying leaden missiles—has to be called lead. Since what we call matter essentially involves a mode of motion, and since at the temperature of absolute zero all atomic motions would stop, it follows that matter, as we know it, would at that paralyzing temperature probably entirely change its properties. Although a discussion of the ultimate absolute properties of matter is purely speculative, it can hardly be barren, considering that in our laboratories we are now within moderate distance of the absolute zero of temperature.

I have dwelt on the value and importance of nitrogen, but I must not omit to bring to your notice those little known and curiously related elements which, during the past 12 months, have been discovered and partly described by Prof. Ramsey and Dr. Travers. For many years my own work has been among what I may call the waste heaps of the mineral elements. Prof. Ramsey is dealing with vagrant atoms of an astral nature. During the course of the present year he has announced the existence of no fewer than three new gases—krypton, neon, and metargon. Whether these gases, chiefly known by their

spectra, are true unalterable elements, or whether they are compounded of other known or unknown bodies, has yet to be proved. Fellow workers freely pay tribute to the painstaking zeal with which Prof. Ramsey has conducted a difficult research, and to the philosophic subtlety brought to bear on his investigations. But, like most discoverers, he has not escaped the flail of severe criticism.

There is still another claimant for celestial honors. Prof. Nasini tells us he has discovered in some volcanic gases at Pozzuoli, that hypothetical element Coronium, supposed to cause the bright line 5,316.9 in the spectrum of the sun's corona. Analogy points to its being lighter and more diffusible than hydrogen, and a study of its properties cannot fail to yield striking results. Still awaiting discovery by the fortunate spectroscopist are the unknown celestial elements Aurorium, with a characteristic line at 5,570.7—and Nebulum, having two bright lines at 5,007.05 and 4,959.02.

The fundamental discovery by Hertz of the electro-magnetic waves, predicted more than 30 years ago by Clerk Maxwell, seems likely to develop in the direction of a practical application which excites keen interest—I mean the application to electric signalling across moderate distances without connecting wires. The feasibility of this method of signalling has been demonstrated by several experimenters at more than one meeting of the British Association, though most elaborately, and with many optical refinements, by Oliver Lodge at the Oxford meeting in 1894. But not until Signor Marconi induced the British Post Office and Foreign Governments to try large scale experiments did wireless signalling become generally and popularly known or practically developed as a special kind of telegraphy. Its feasibility depends on the discovery of a

singularly sensitive detector for Hertz waves—a detector whose sensitiveness in some cases seems almost to compare with that of the eye itself. The fact noticed by Oliver Lodge in 1889, that an infinitesimal metallic gap subjected to an electric jerk became conducting, so as to complete an electric circuit, was rediscovered soon afterwards in a more tangible and definite form and applied to the detection of Hertz waves by M. E. Branly. Oliver Lodge then continued the work, and produced the *vacuum filing-tube* coherers with automatic tapperback, which are of acknowledged practical service. It is this varying continuity of contact under the influence of extremely feeble electric stimulus alternating with mechanical tremor, which, in combination with the mode of producing the waves revealed by Hertz, constitutes the essential and fundamental feature of “wireless telegraphy.” There is a curious and widely-spread misapprehension about coherers to the effect that to make a coherer work the wave must fall upon it. Oliver Lodge has disproved this fallacy. Let the wave fall on a suitable receiver, such as a metallic wire, or, better still, on an arrangement of metal wings resembling a Hertz sender, and the waves set up oscillating currents which may be led by wires (inclosed in metal pipes) to the coherer. The coherer acts apparently by a species of end-impact of the oscillatory current, and does not need to be attacked in the flank by the waves themselves. This interesting method of signalling—already developing in Marconi’s hands into a successful practical system, which inevitably will be largely used in lighthouse and marine work—presents more analogy to optical signals by flash-light than to what is usually understood as electric telegraphy, notwithstanding the fact that an ordinary Morse instrument at one end responds to the movements of a key at

the other, or, as arranged by Alexander Muirhead, a siphon recorder responds to an automatic transmitter at about the rate of slow cable telegraphy. But although no apparent optical apparatus is employed, it remains true that the impulse travels from sender to receiver by essentially the same process as that which enables a flash of magnesium powder to excite a distant eye.

The phenomenon discovered by Zeeman, that a source of radiation is affected by a strong magnetic field in such a way that light of one refrangibility becomes divided usually into three components, two of which are displaced by diffraction analysis on either side of the mean position, and are oppositely polarized to the third or residual constituent, has been examined by many observers in all countries. The phenomenon has been subjected to photography with conspicuously successful results by Prof. T. Preston in Dublin, and by Prof. Michelson and Dr. Ames and others in America.

It appears that the different lines in the spectrum are differently affected, some of them being tripled with different grades of relative intensity, some doubled, some quadrupled, some sextupled, and some left unchanged. Even the two components of the D lines are not similarly influenced. Moreover, whereas the polarization is usually such as to indicate that motions of a negative ion or electron constitute the source of light, a few lines are stated by the observers at Baltimore, who used what they call the “small” grating of 5 inches width ruled with 65,000 lines, to be polarized in the reverse way.

Further prosecution of these researches must lead to deeper insight into molecular processes and the mode in which they affect the ether; indeed, already valuable theoretic views have been promulgated by H. A. Lorenz, J. Larmor, and G. F. Fitzgerald, on the lines of

the radiation theory of Dr Johnstone Stoney; and the connection of the new phenomena with the old magnetic rotation of Faraday is under discussion. It is interesting to note that Faraday and a number of more recent experimenters were led by theoretical considerations to look for some such effect; and though the inadequate means at their disposal did not lead to success, nevertheless a first dim glimpse of the phenomenon was obtained by M. Fievez, of the Royal Observatory at Brussels, in 1885.

It would be improper to pass without at least brief mention the remarkable series of theoretic papers by Dr. J. Larmor, published by the Royal Society, on the relationship between ether and matter. By the time these researches become generally intelligible they may be found to constitute a considerable step towards the further mathematical analysis and interpretation of the physical universe on the lines initiated by Newton.

In the mechanical construction of Roentgen ray tubes I can record a few advances, the most successful being the adoption of Prof. Silvanus P. Thompson's suggestion of using for the anti-cathode a metal of high atomic weight. Osmium and iridium have been used with advantage, and osmium anti-cathode tubes are now a regular article of manufacture. As long ago as June, 1896, x-ray tubes with metallic uranium anti-cathodes were made in my own laboratory, and were found to work better than those with platinum. The difficulty of procuring metallic uranium prevented these experiments from being continued. Thorium anti-cathodes have also been tried.

Roentgen has drawn fresh attention to a fact very early observed by English experimenters—that of the non-homogeneity of the rays and the dependence of their penetrating power on the degree of vacuum; rays generated in high vacua

have more penetrative power than when the vacuum is less high. These facts are familiar to all who have exhausted focus tubes on their own pumps. Roentgen suggests a convenient phraseology; he calls a low vacuum tube, which does not emit the highly penetrating rays, a "soft" tube, and a tube in which the exhaustion has been pushed to an extreme degree, in which highly penetrating rays predominate, a "hard" tube. Using a "hard" tube he took a photograph of a double-barrelled rifle, and showed not only the leaden bullets within the steel barrels but even the wads and the charges.

Benoit has re-examined the alleged relation between density and opacity to the rays, and finds certain discrepancies. Thus, the opacity of equal thicknesses of palladium and platinum are nearly equal, whilst their densities and atomic weights are very different, those of palladium being about half those of platinum.

At the last meeting of the British Association visitors saw—at the McGill University—Profs. Cox and Callendar's apparatus for measuring the velocity of Roentgen rays. They found it to be certainly greater than 200 kilometers per second. Majorana has made an independent determination and finds the velocity to be 600 kilometers per second, with an inferior limit certainly of not less than 150 kilometers per second. It may be remembered that J. J. Thomson has found for cathode rays a velocity of more than 10,000 kilometers per second, and it is extremely unlikely that the velocity of Roentgen rays will prove to be less.

Trowbridge has verified the fact, previously announced by Prof. S. P. Thompson, that fluor-spar, which by prolonged heating has lost its power of luminescing when re-heated, regains the power of thermo-luminescence when exposed to Roentgen rays. He finds that this restoration is also effected by exposure

to the electric glow discharge, but not by exposure to ultra-violet light. The difference is suggestive.

As for the action of Roentgen rays on bacteria, often asserted and often denied, the latest statement by Dr. H. Rieder, of Munich, is to the effect that bacteria are killed by the discharge from "hard" tubes. Whether the observation will lead to results of pathologic importance remains to be seen. The circumstance that the normal retina of the eye is slightly sensitive to the rays is confirmed by Dorn and by Roentgen himself.

The essential wave nature of the Roentgen rays appears to be confirmed by the fact ascertained by several of our great mathematical physicists, that light of excessively short wave length would be but slightly absorbed by ordinary material media, and would not in the ordinary sense be refracted at all. In fact, a theoretic basis for a comprehension of the Roentgen rays had been propounded before the rays were discovered. At the Liverpool meeting of the British Association, several speakers, headed by Sir George Stokes, expressed their conviction that the disturbed electric field caused by the sudden stoppage of the motion of an electrically charged atom yielded the true explanation of the phenomena extraneous to the Crookes high vacuum tubes—phenomena so excellently elaborated by Lenard and by Roentgen. More recently, Sir George Stokes has re-stated his "pulse" theory and fortified it with arguments which have an important bearing on the whole theory of the refraction of light. He still holds to their essentially transverse nature, in spite of the absence of polarization, an absence once more confirmed by the careful experiments of Dr. L. Graetz. The details of this theory are in process of elaboration by Prof. J. J. Thomson.

Meantime, while the general opinion

of physicists seems to be settling toward a wave or ether theory for the Roentgen rays, an opposite drift is apparent with respect to the physical nature of the cathode rays; it becomes more and more clear that cathode rays consist of electrified atoms or ions in rapid progressive motion. My idea of a fourth state of matter, propounded in 1881,* and at first opposed at home and abroad, is now becoming accepted. It is supported by Prof. J. J. Thomson;† Dr. Larmor's theory‡ likewise involves the idea of an ionic substratum of matter; the view is also confirmed by Zeeman's phenomenon. In Germany—where the term cathode ray was invented almost as a protest against the theory of molecular streams propounded by me at the Sheffield meeting of the British Association in 1879—additional proofs have been produced in favor of the doctrine that the essential fact in the phenomenon is electrified radiant matter.

The speed of these molecular streams has been approximately measured, chiefly by aid of my own discovery nearly 20 years ago, that their path is curved in a magnetic field, and that they produce phosphorescence where they impinge on an obstacle. The two unknown quantities, the charge and the speed of each atom, are measurable from the amount of curvature and by means of one other independent experiment.

It can not be said that a complete and conclusive theory of these rays has yet been formulated. It is generally accepted that collisions among particles, especially the violent collisions due to their impact on a massive target placed in their path, give rise to the interesting kind of extremely high frequency radiation discovered by Roentgen. It has, indeed, for some time been known that whereas a charged body in motion con-

*Phil. Trans., Part 2, 1881, pp. 433-4.

†Phil. Mag., October, 1897, p. 312.

‡Phil. Mag., December, 1897, p. 506.

stitutes an electric current, the sudden stoppage, or any violent acceleration of such a body must cause an alternating electric disturbance, which, though so rapidly decaying in intensity as to be practically "dead beat," yet must give rise to an ethereal wave or pulse traveling with the speed of light, but of a length comparable to the size of the body whose sudden change of motion caused the disturbance. The emission of a high-pitched musical sound from the jolting of a dustman's cart (with a spring bell hung on it) has been suggested as an illustration of the way in which the molecules of any solid not at absolute zero may possibly emit such rays.

If the target onto which the electrically charged atoms impinge is so constituted that some of its minute parts can thereby be set into rhythmical vibration, the energy thus absorbed reappears in the form of light, and the body is said to phosphoresce. The efficient action of the phosphorescent target appears to depend as much on its physical and molecular, as on its chemical constitution. The best known phosphori belong to certain well-defined classes, such as the sulphides of the alkaline earthy metals, and some of the so-called rare earths, but the phosphorescent properties of each of these groups are profoundly modified by an admixture of foreign bodies—witness the effect on the lines in the phosphorescent spectrum of yttrium and samarium, produced by traces of calcium or lead. The persistence of the samarium spectrum in presence of overwhelming quantities of other metals, is almost unexampled in spectroscopy; thus one part of samaria can easily be seen when mixed with three million parts of lime.

Without stating it as a general rule, it seems as if, with a non-phosphorescing target, the energy of molecular impact reappears as pulses so abrupt, and irregular, that, when resolved, they fur-

nish a copious supply of waves of excessively short wave lengths; in fact, the now well-known Roentgen rays. The phosphorescence so excited may last only a small fraction of a second, as with the constituents of yttria, where the duration of the different lines varies between the 0.003 and the 0.0009 second, or it may linger for hours, as in the case of some of the yttria earths, and especially with the earthy sulphides, where the glow lasts bright enough to be commercially useful. Excessively phosphorescent bodies can be excited by light waves, but most of them require the stimulus of electrical excitement.

It now appears that some bodies, even without special stimulation, are capable of giving out rays closely allied, if not in some cases identical, with those of Prof. Roentgen. Uranium and thorium compounds are of this character, and it would almost seem from the important researches of Dr. Russell, that this ray-emitting power may be a general property of matter, for he has shown that nearly every substance is capable of affecting the photographic plate if exposed in darkness for sufficient time.

No other source for Roentgen rays but the Crookes tube has yet been discovered, but rays of kindred sorts are recognized. The Becquerel rays, emitted by uranium and its compounds, have now found their companions in rays—discovered almost simultaneously by Curie and Schmidt—emitted by thorium and its compounds. The thorium rays affect photographic plates through screens of paper or aluminum, and are absorbed by metals and other dense bodies. They ionise the air, making it an electrical conductor; and they can be refracted and probably reflected, at least diffusively. Unlike uranium rays, they are not polarized by transmission through tourmaline, therefore resembling in this respect the Roentgen rays.

Quite recently M. and Mme. Curie

have announced a discovery which, if confirmed, cannot fail to assist the investigation of this obscure branch of physics. They have brought to notice a new constituent of the uranium mineral pitchblende, which, in a 400-fold degree, possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate, and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body to which the discoverers have given the name of Polonium, needs neither the excitation of light nor the stimulus of electricity; like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount.

It has long been to me a haunting problem how to reconcile this apparently boundless outpour of energy with accepted canons. But as Dr. Johnstone Stoney reminds me, the resources of molecular movements are far from exhausted. There are many stores of energy in nature that may be drawn on by properly constituted bodies without very obvious cause. Some time since I drew attention to the enormous amount of locked up energy in the ether; nearer our experimental grasp are the motions of the atoms and molecules, and it is not difficult mentally so to modify Maxwell's demons as to reduce them to the level of an inflexible law, and thus bring them within the ken of a philosopher in search of a new tool. It is possible to conceive a target capable of mechanically sifting from the molecules of the surrounding air the quick from the slow movers. This sifting of the swift moving molecules is effected in liquids whenever they evaporate, and in the case of the constituents of the atmosphere, wherever it contains constituents light enough to drift away molecule by molecule. In my mind's eye I see such a target as a piece of metal cooler than the surrounding air ac-

quiring the energy that gradually raises its temperature from the outstanding effect of all its encounters with the molecules of the air about it; I see another target of such a structure that it throws off the slow-moving molecules with little exchange of energy, but is so influenced by the quick-moving missiles that it appropriates to itself some of their energy. Let uranium or polonium, bodies of densest atoms, have a structure that enables them to throw off the slow-moving molecules, of the atmosphere, while the quick-moving molecules, smashing on to the surface, have their energy reduced, and that of the target correspondingly increased. The energy thus gained seems to be employed partly in dissociating some of the molecules of the gas (or in inducing some other condition which has the effect of rendering the neighboring air in some degree a conductor of electricity) and partly in originating an undulation through the ether, which, as it takes its rise in phenomena so disconnected as the impacts of the molecules of the air, must furnish a large contingent of light waves of short wave length. The shortness in the case of these Becquerel rays appears to approach without attaining the extreme shortness of ordinary Roentgen rays. The reduction of the speed of the quick moving molecules would cool the layer of air to which they belong; but this cooling would rapidly be compensated by radiation and conduction from the surrounding atmosphere; under ordinary circumstances the difference of temperature would scarcely be perceptible, and the uranium would thus appear to perpetually emit rays of energy with no apparent means of restoration.

The total energy of both the translational and internal motions of the molecules locked up in quiescent air at ordinary pressure and temperature is about 140,000 foot-pounds in each cubic yard

of air. Accordingly the quiet air within a room 12 feet high, 18 feet wide, and 22 feet long contains energy enough to propel a 1-horse engine for more than 12 hours. The store drawn upon naturally by uranium and other heavy atoms only awaits the touch of the magic wand of science to enable the twentieth century to cast into the shade the marvels of the nineteenth.

Whilst placing before you the labors and achievements of my comrades in science, I seize this chance of telling you of engrossing work of my own on the fractionation of yttria, to which, for the last 18 years, I have given ceaseless attention. In 1883, under the title of "Radiant Matter Spectroscopy," I described a new series of spectra produced by passing the phosphorescent glow of yttria, under molecular bombardment *in vacuo*, through a train of prisms. The visible spectra in time gave up their secrets, and were duly embalmed in the *Philosophical Transactions*. At the Birmingham meeting of the British Association in 1886 I brought the subject before the Chemical Section, of which I had the honor to be President. The results led to many speculations on the probable origin of all the elementary bodies—speculations that, for the moment, I must waive in favor of experimental facts.

There still remained for spectroscopic examination a long tempting stretch of unknown ultra-violet light, of which the exploration gave me no rest. But I will not now enter into details of the quest of unknown lines. Large quartz prisms, lenses, and condensers, specially sensitized photographic films, capable of dealing with the necessary small amount of radiation given by feebly phosphorescing substances,* and above all tireless patience in collating and interpreting re-

sults, have all played their part. Although the research is incomplete, I am able to announce that among the groups of rare earths giving phosphorescent spectra in the visible region, there are others giving well defined groups of bands, which can only be recorded photographically. I have detected and mapped no less than six such groups, extending λ 3,060.

Without enlarging on difficulties, I will give a brief outline of the investigation. Starting with a large quantity of a group of the rare earths in a state of considerable purity, a particular method of fractionation is applied, splitting the earths into a series of fractions differing but slightly from each other. Each of these fractions, phosphorescing *in vacuo*, is arranged in the spectograph, and a record of its spectrum photographed upon a specially prepared sensitive film.

In this way, with different groups of rare earths, the several invisible bands were recorded—some moderately strong, others exceedingly faint. Selecting a portion giving a definite set of bands, new methods of fractionation were applied, constantly photographing and measuring the spectrum of each fraction. Sometimes many weeks of hard experiment failed to produce any separation, and then a new method of splitting up was devised and applied. By unremitting work—the solvent of most difficulties—eventually it was possible to split up the series of bands into various groups. Then, taking a group which seemed to offer possibilities of reasonably quick result one method after another of chemical attack was adopted, with the ultimate result of freeing the group from its accompanying fellows and increasing its intensity and detail.

As I have said, my researches are far from complete, but about one of the bodies I may speak definitely. High up in the ultra-violet, like a faint nebula in the distant heavens, a group of lines was de-

*In this direction I am glad to acknowledge my indebtedness to Dr. Schuman, of Leipzig, for valuable suggestions and detail of his own apparatus, by means of which he has produced some unique records of metallic and gaseous spectra of lines of short wave-length.

tected, at first feeble, and only remarkable on account of their isolation. On further purification these lines grew stronger. Their great refrangibility cut them off from other groups. Special processes were employed to isolate the earth, and using these lines as a test, and appealing at every step to the spectrograph, it was pleasant to see how each week the group stood out stronger and stronger, while the other lines of yttrium, samarium, ytterbium, &c., became fainter, and at last, practically vanishing, left the sought-for group strong and solitary. Finally, within the last few weeks, hopefulness has emerged into certainty, and I have absolute evidence that another member of the rare earth groups has been added to the list. Simultaneously with the chemical and spectrographic attack, atomic weight determinations were constantly performed.

As the group of lines which betrayed its existence stand alone, almost at the extreme end of the ultra-violet spectrum, I propose to name the newest of the elements monium, from the Greek term, alone. Although caught by the searching rays of the spectrum, monium offers a direct contrast to the recently discovered gaseous elements, by having a strongly marked individuality; but although so young and wilful, it is willing to enter into any number of chemical alliances.

Until my material is in a greater state of purity I hesitate to commit myself to figures; but I may say that the wave lengths of the principal lines are 3,120 and 3,117. Other fainter lines are at 3,219, 3,064, and 3,060. The atomic weight of the element, based on the assumption of R_2O , is not far from 118—greater than that accepted for yttrium, and less than that for lanthanum.

I ought almost to apologize for adding to the already too long list of elements of the rare earth class—the asteroids of the terrestrial family. But as the host

of celestial asteroids, unimportant individually, become of high interest when once the idea is grasped that they may be incompletely coagulated remains of the original nebula, so do these elusive and insignificant rare elements rise to supreme importance when we regard them in the light of component parts of a dominant element, frozen in embryo, and arrested in the act of coalescing from the original protyle into one of the ordinary and law-abiding family for whom Newlands and Mendeleeff have prepared pigeon-holes. The new element has another claim to notice. Not only is it new in itself, but to discover it a new tool had to be forged for spectroscopic research.

Further details I will reserve for that tribunal before whom every aspirant for a place in the elemental hierarchy has to substantiate his claim.

ATMOSPHERIC DISCHARGES. Montel. *L'Eclairage Elec.*, July 30. *Electrical World*, N. Y.—When lightning strikes near a closed circuit the latter becomes the seat of a temporary current, representing a certain amount of power; in the present article, which is of a theoretical and highly mathematical character, he discusses the power developed in that close circuit; this is based on the known laws of discharge of condensers. He concludes that if in the case of an atmospheric discharge it is possible to measure two integral values of the square of the current by the differential of the time induced in each of two circuits, in one of which the ratio of the resistance to the co-efficient of self-induction is very small, while in the other it is very large, it becomes possible to find out, by comparison of these two integrals, the nature of the atmospheric discharge.

DISCHARGE BY X-RAYS. Sagnac. *L'Eclairage Elec.*, July 23. *Electrical World*, N. Y.—An Academy note on the mechanism of the discharge by x-rays.

**EXPERIMENTS ON THE APPLICATION
OF THE ROENTGEN RAYS TO THE
STUDY OF ANATOMY.**

BY ERNEST AMORY CODMAN, M. D., BOSTON.

This paper is the report by the author to the Committee on the Bullard Fellowship, of the Harvard Medical School, May, 1, 1897. After adverting to the fact that in pathological conditions of bone the x-ray can reveal what the dissecting-knife and frozen sections can not, the author proceeds:

In looking at skiagraphs there are several distortions and inaccuracies which must be borne in mind. One essential for a good skiagraph is an accurately focussed tube. The cathode rays are focussed by a concave aluminum electrode on the center of a disc of platinum or the anode. The point where the stream of cathode rays strikes is the point from which the x-rays are generated. That this point should be as small as possible is important, in order that no penumbra should be formed.

We may consider, then, that the x-rays proceed from practically a single point. In looking at a skiagraph, we must consider it as a complete whole, made up of the shadows of the different parts of the object. The size and shape of the shadow of each part will depend upon the relations of the distances between the point of light, the part of the object, and the plate. Thus the distance between the light and the plate remaining the same, the farther an object is from the plate, the larger will be its shadow; and the farther an object, or part of an object, from the base of a perpendicular from the point of light to the plate of the plate, the more will its shadow be distorted, the distortion being due to elongation in the direction of a line from the base of the perpendicular through the object.

When the object is at the same time away from the plate and away from the

base of the perpendicular, both of these distortions will take place. Further, since each object or part of an object contains only a certain amount of shadow-casting material, the farther it is from the plate, the greater will be the size and the less the density of the shadow.

An important corollary follows from this. A picture of a less dense object may be taken through a more dense, *e.g.*, the ear through the skull. This can be done when the densities of the two objects are not greatly contrasted; but when one object is so dense as to be practically impenetrable to the rays, its shadow will of course obliterate the shadows of anything either in front of or behind it. This is generally true of metallic objects.

Another source of inaccuracy of these pictures is the fact that the rays, in penetrating large objects, are more or less diffused. This diffusion tends to blur the outlines of the parts of the object at a distance from the plate. It may also assist in making more distinct the objects in direct contact with the plate; for instance in the picture of the ear taken through the skull, the diffused rays from the other parts of the head may help to take the picture of the ear, because they blur all those parts of the plate which are not protected by the ear, which comes in close contact with the wrapper.

It will be seen from the foregoing that in order to reduce these inaccuracies to a minimum the distance from the plate to the tube should be as great as possible, and that from the object to the plate as short as possible. The distance, therefore, must be gauged by the intensity of the rays and convenient time of exposure. We must also remember that the wider the object, or the deeper the object, the greater must be the distance between the plate and the tube. For instance, the skiagraph of a hand at 10 inches is very little distorted, while that

of two hands side by side would be considerably distorted, because the rays would strike the outer fingers at more acute angles.

A knee at 10 inches, though little wider than a hand, would yet be considerably distorted, for it is so thick that the parts furthest from the plate would be much enlarged; the external condyle of the femur (the knee being on the inner side, for instance) would appear much larger than the internal.

In order to reduce these distortions to a minimum, the tube should be put as far away as is possible with a convenient time of exposure.

On the other hand, however, advantage can be taken of this distortion in taking a photograph of the patella. If the plate is put to the posterior side of the knee, the shadow of the patella will be hardly, if at all, distinguishable. This would be true also if the plate were on the anterior side and the light far away, for the shadow of the femur would be dense enough to overshadow that of the patella. If, however, the plate be on the anterior side, and the tube very near the posterior, the shadow of the femur will be broadened and diminished in density, so that the shadow of the patella, which is but little magnified and as dense as before, will be seen through it.

The use of the fluoroscope is a practical way of determining the intensity of the rays. In determining the distance, we must remember that the intensity of the light varies inversely as the square of the distance. In determining the time, we can calculate that what we lose by doubling the distance we gain by multiplying the time of exposure by four.

THE STUDY OF THE MECHANISM OF THE JOINTS.

This has been undertaken in two ways. First, by skiagraphing the normal joints in their forced extreme positions, extreme flexion, adduction, etc. Secondly, by watching the movements with the

fluoroscope. As the parts of the object near the plate show best, it has been necessary to take each position from both sides.

One thing which will at once arrest attention is the great distance that apparently intervenes between the bones. This is in part due to the fact that the articular cartilages, being easily traversed by the rays, do not cast a shadow.

The wrist-joint has proved most interesting in this study, and the points brought out will be found in the following description:

For convenience, we may consider the wrist-joint to be made up of four immobile and two mobile elements.

I. Immobile (*i. e.*, those made up of single bones or of a group of bones, the components of which can not change relative positions). These are:

1. Metacarpal of thumb.
2. Metacarpal of ring-finger.
3. Metacarpal of little finger.
4. Metacarpal of index and middle finger with trapezium, trapezoid, os magnum, and unciform.

This last group are so firmly attached to one another that they move as a whole, practically as one bone. No doubt, however, their ligamentous attachments allow of more or less spring in strained positions of the hand brought about by external force.

II. Mobile (the components of which change relative positions).

1. The intermediate row of carpal bones composed of scaphoid, semilunar, cuneiform, and pisiform.
2. Radius and ulna.

From skiagraphs it is found that the carpus and metacarpus are, in any of the extreme positions, in practically the same relation to the radius, no matter what the relation of the radius to the ulna, whether pronation or supination. This is due to the more or less flexible fibrocartilage, which in any position completes the cup of the radial joint. The

question of mechanism, then, is further simplified by leaving out the ulna, which really does not enter into the construction of the joint except as a pivot. The pisiform also does not enter the mechanism, serving only as a sesamoid for the ulnar tendons.

Proceeding to eliminate other accessory elements, we can disregard the metacarpals of the thumb, ring and index fingers, each of which moves independently on the large fixed element composed of the os magnum, etc. The thumb forms a typical saddle joint with the trapezium, with the pommels of the saddle so low that motion is allowed in a small circle, either as rotation within the circumference or straight motions on any of the radii. The metacarpal of the ring-finger is allowed a slight antero-posterior motion of a few degrees. That of the little finger the same of slightly greater extent, with possibly a degree of adduction. This leaves us with:

I. The large compound fixed element of os magnum, etc.

II. The radius with fibro-cartilage.

III. The intermediate element of scaphoid, semilunar, and cuneiform.

These constitute the real wrist joint.

NEW RADIO-ACTIVE SUBSTANCES. P. and S. Curie. *L'Eclairage Elec.*, August 6. *The Electrical World*, N. Y.—A reprint of an Academy paper. They found that certain minerals containing uranium and thorium are very active in the emission of Becquerel rays, the activity being even greater than that of uranium or thorium, and it was thought that this was due to some other very active substance included in these minerals, as, for instance, pitch-blende, the protoxide of uranium. They suggested this may be a new element, and if its existence can be confirmed the discovery of it was due to its production of Becquerel rays.

THE X-RAY IN LAW.

BY HUGO WINTNER, B.S., LL.B.

A discussion of this topic must, to a great degree, of necessity be speculative in its nature; for but few actual cases have been passed upon by the courts, in which the x-ray has been an element. Naturally the question which propounds itself first is whether an x-ray picture may be introduced in evidence on the trial of a case, as proof of the existence of the condition by it shown. Thus in an action for personal injuries, may the x-ray picture of a fractured limb be put in evidence to show the existence, the nature and the extent of the fractures. It is now the best opinion that it may be so introduced and that the jury may be permitted to inspect it, provided always that the condition to be shown by the photograph is in issue or relative to the issue at bar. Furthermore, a photograph being from its nature secondary evidence merely, as contradistinguished from the best evidence, the proper foundation for its reception as evidence must first be laid by the party introducing it. Thus the expert must first testify to the reliability of the x-ray machine, its nature and process, the degree of exactness, etc. The reason that it is at all of any legal value in the trial of a case, is the fact that science and human experience have proven that the machine is capable of giving an exact reproduction, if properly and scientifically used. Hence the necessity of first showing, and this carefully, that the machine and the working of it in the particular case at bar were all that was necessary for its complete effectiveness. The sufficiency of the proof first required to verify the picture is a preliminary question of fact for the judge presiding at the trial, and is not open to exception.

The statutes of New York State provide

(Sect. 873, C. C. P.) that in an action for personal injury, the court, on the defendant showing certain facts by affidavit, and applying therefor, may direct the plaintiff to submit to a physical examination by one or more physicians or surgeons to be designated by the court; and such examination shall be had and made under such restrictions and directions as to the court shall seem proper.

Quaere I.—Granted the fact that the x-ray machine has certain dangerous qualities inherent in its workings, may the court nevertheless order a plaintiff to subject himself to its dangers?

II.—Suppose that upon subjecting himself to the machine, if so desired by the court, he were injured thereby; has he redress for his injuries, and to whom could he look for such redress?

I.—It will be noted that the section referred to gives the court power to make such restrictions and directions as it may deem proper. It will be seen, therefore, that whether or not a plaintiff must submit himself to x-ray examination, is discretionary with the court. It could not well be argued that the plaintiff could object to the use of a temperature thermometer, for instance, or a stethoscope in the hands of the examining physician. Why then to the use of any other instrument recognized by the medical and scientific world and necessary to the examiner in acquiring the information sought? No case touching the subject has yet been brought before the courts for adjudication; hence one opinion is good until another be ventured. It has, however, been decided that the section so far as the ordering of a physical examination is concerned is not violative of any Constitutional inhibition.

II.—In case of injury to plaintiff by use of the x-ray machine, he would have redress. The judge ordering the examination would incur no liability. He acts merely in a judicial capacity, in which

he is called upon to exercise his discretion; and he is not liable for error of judgment, even though it be alleged that he acted without due care and prudence (*Lange vs. Benedict*, N. Y., 35). The injured plaintiff's remedy must be sought against the physician, under whose charge the instrument was at the time of the accident. *Ayers vs. Russell et al.*, decided in N. Y. State in 1888, was an action brought against two physicians for damages arising out of plaintiff's confinement in a mad house. The physicians, acting pursuant to certain statutes of lunacy then in force, had signed a certificate that the plaintiff was a lunatic. On appeal from the order of the judge committing him, which order was based on such certificate, the plaintiff was judicially declared *compos mentis*. The defendants sought to defend on the ground that as they were acting pursuant to statute, they were judicial officers. The court, however, decided that their duty must be measured by the trust reposed in them by the statute, and by the consequences flowing from its improper performance. They assumed the duty by accepting the trust. They were merely medical experts and not clothed with judicial immunity, and were chargeable with that negligence which attaches to a professional expert who does not use the skill and care which his profession per se implies that he will bring to bear. Hence, if it be charged and proved that the physician in charge of the machine did not use proper care and prudence in handling it, he must respond in damages to the one injured through such negligence.

—*Journal of Electro Therapeutics.*

ARC BETWEEN ALUMINUM ELECTRODES.
Lang. *Wied. Ann.*, December; abstracted briefly in *L'Eclairage Elec.*, July 30. *Electrical World*. He determined the counter E. M. F. of the arc between aluminum electrodes.

SURGERY AND THE X-RAY.

In the concluded report of surgical operations in the Private Surgical Infirmary of Drs. C. S. and Samuel S. Briggs, the following extracts are of interest:

CASE LXXVIII.—*Tuberculosis of the Great Trochanter.* J. L. S., æt. 37, male, Erin, Tenn., entered February 7. Ankylosis of the right hip joint, the hip very much swollen and numerous fistulae, gave a history of traumatism. The probe failed to touch necrosed bone. The x-ray was used and radiographs made, they showed marked hypertrophy of the trochanter major and the neck. Under A. C. E. two and a half ounces, nausea and vomiting, an incision was made over the trochanter, exposing it well, and an opening was made with the chisel into the bone, considerable disease was found and removed by curetting. The sinuses were all laid open and packed with gauze, and dressed daily. The patient was relieved entirely of pain and tenderness and went home greatly improved.

CASE XCIII.—*Amputation of Tocs.* F. W. B., æt. 64, male, Nashville, entered March 10. Obliterative endarteritis, beginning senile gangrene. Under A. C. E., two and a half ounces, amputation of little toe was done. The wound was partially closed, failure of healing. Recurrence of mortification, amputation of the leg at the point of election was required later, terminating fatally. X-ray showed calcareous degeneration of the tibial arteries.

CASE XCVI.—*Removal of Bullet.* Mrs. R., æt. 40, Nashville, entered March 15. Was accidentally shot in the left calf, difficulty was experienced in efforts to locate the ball with the probe. With the x-ray the bullet was clearly seen and its location marked with silver nitrate, also a radiograph was made. Guided by these markings an incision was made

large enough to admit the fingers and the ball, which was found wrapped in cloth, accounting for the difficulty of locating with a probe, was removed. The wound was lightly packed with gauze.

CASE CXIX.—*Laminectomy.* R. A. W., æt. 30, male, Hartsville, Tenn., entered May 16. Paraplegia from a fracture of the vertebrae, from an injury which occurred two months previously. The deformity had been reduced at the time of injury, the paralysis had not progressed. Examination with the x-ray showed some irregularity and thickening about the 11th and 12th dorsal, and 1st lumbar vertebrae. Fecal and urinary incontinence were not complete. Under A. C. E., two ounces, vomiting, laminectomy was done, an eight inch incision was made over the spinous processes, and the muscles were pushed off from the vertebrae with a periosteal elevator, exposing the laminae and spines, which were removed with the rongeur forceps, exposing the cords nicely, and removing the pressure. The cord was in good condition; the canal was explored for further pressure with a probe. The muscles were closed over the cord with buried catgut sutures, and the wound closed over a drainage tube. The hemorrhage was slight. The wound discharged freely for some time. Improvement was slight at first but sensibility gradually increased, and he was able to return home July 15.

CASE CXXII.—*Medio-bilateral Lithotomy.* S. W. T., æt. 24, male, Winchester, Tenn., entered May 26. The symptoms of vesical calculus had existed for some time, but repeated examinations failed to disclose stone. In an examination a few days before the operation the water was forcibly ejected along the sides of the searcher, during which the stone was drawn against the instrument. The presence of stone was further demonstrated by the cystoscope and the x-ray. Under A. C. E., one ounce, no

nausea, the calculus was removed by the medio-bilateral method, a drainage tube was inserted, and the wound was lightly packed with gauze. Urine passed per vias naturales on the sixth day, and the wound healed rapidly.

CASE CLX.—*Coxitis*. K. C., æt. 12, F., Nashville, entered July 18. An extreme case of hip joint disease. Examined with the x-ray to determine the advisability of excision. Two radiographs were made showing the absorption of the head of the femur, but no sequestra could be located.—*Nashville Journal of Medicine and Surgery*.

The Influence of the X-ray Method of Diagnosis Upon the Treatment of Fractures.

In remarking on the benefits which this new method of diagnosis has conferred upon the treatment of fractures, Leonard (*Therapeutic Gazette*, March, 1898,) says: "It can not be expected of any new method of diagnosis that it will replace or at first even equal methods which have attained accuracy and scientific precision by the study of generations of observers, and yet this new method of diagnosis has already produced results which markedly affect the treatment of certain forms of fractures."

The greatest value in the determination of the exact nature of injuries and the point where danger is to be expected from exuberant callus, or the blocking of the joint by overlapping of the fragments. In many instances fractures that lie wholly within the capsule of the joint, and thus escape detection, are distinctly shown and are rendered amenable to treatment other than that for "bad sprains."

"Many fractures which have been described as rare have been shown by this method to have been rarely detected, while the exact determination of the form of fracture and the recognition of minute comminuted fragments have

rendered coaptation more precise and the result of treatment more perfect."

One of the greatest influences of this method upon the treatment of fractures is the change it is bringing about in prognosis. Antisepsis has robbed the compound fracture of its gravity and the skiagraph has shown that in many cases the simple fracture is much more dangerous and liable to be followed by greater deformity and loss of function, and that its name is often a misnomer. The author advocates the change suggested by others of the terms open and closed for simple and compound; and advises in many instances the treatment of simple fractures by open operation, claiming that under aseptic precautions there is no danger commensurate with the advantages gained.

Of the medico-legal value of the skiagraph he says: "There seems to be no doubt that the only ground for damages in suits for malpractice must be, as formerly, based upon expert testimony as to the amount of deformity and functional disability of the patient. . . . There is, however, reasonable ground for holding that unless a skiagraphic examination of the fracture has been made, or at least suggested by the practitioner and declined by the patient, it can not hereafter be said that where functional disability exists the practitioner has employed all reasonable and ordinary means, to the best of his ability, in the treatment of the fracture."—*Nashville Journal of Medicine and Surgery*.

DARK CATHODE SPACE. Wehnelt. *Wied. Ann.* No. 7; abstracted briefly in *Lond. Elec.* July 29. *Electrical World*, N. Y. He investigated the nature of the discharge in the dark cathode space, by means of a coherer. The results go to prove that the discharge through the dark space has a disruptive character, just as though this space was a dielectric like paraffin oil.

LONDON ITEMS.

J. W. BARBOUR, M. D.

Librarian Roentgen Society, London, Correspondent.

The Roentgen Rays in the Treatment of Hypertrichosis.

Dr. Eduard Schiff and Dr. Leopold Freund have recently published in the *Wiener Medizinische Wochensh.* (Nos. 22-24, 1898) a description of the removal of superfluous hairs (hypertrichosis) by means of the Roentgen rays. It appears from the cases which they give in their paper that hypertrichosis may be successfully relieved by this means. In order to avoid the production of inflammation they use a current which does not exceed a maximum of 2 amperes, the maximum tension being $11\frac{1}{2}$ volts, and the source of the light is placed at a distance of 20 to 25 centimeters from the skin which is to be subjected to the influence of the rays, which are not allowed to act for a longer period than ten minutes. (When it is desirable to produce inflammation for some therapeutic purpose $3\frac{1}{2}$ amperes, $12\frac{3}{4}$ volts, and a distance of 10 centimeters are employed.) The apparatus which they used is supplied by M. Kohl, in Chemnitz. They report the result of treatment in two lupus cases and seven cases of epilation. In their cases of epilation they obtained the best therapeutic result after seventeen to thirty sittings of short duration. In several of their cases they noticed that from one to two days before the hair fell out the skin showed a brownish discoloration, which disappeared in three to four days after the hair fell out. In several brunettes the hair became, before it fell out, snow-white. They confirm the observation of Freund, and later of Foster and others, that the effect of the rays is cumulative. Schiff was the first to publish a case in which lupus seemed to be cured by the x-rays, and the cases reported by the authors seem to confirm the

result. In the parts treated, where there were previously lupus nodules, there is now small red depressed cicatrices under the level of the skin. From the report of Dr. Schiff and Dr. Freund it appears to be established that hair may be loosened and removed from the skin by the influence of the x-rays, and they append to their paper a footnote, in which they state that Dr. Joseph Jutassy has, since Freund's first publication, treated forty cases of hypertrichosis by the x-rays, and in some of them there had been no regrowth of hair after a year.

A PHOTOGRAPHER'S SKIN DISEASE.—

Dr. Leopold Freund has called attention to an affection of the skin of the fingers which in recent years he had observed in photographers. In a well-marked case the flexor surface of all the fingers of both hands was the seat of a diffuse dark blue-redness, which disappeared under the pressure of the fingers. The skin felt hard and thickened, and the fingers looked larger than normal. The appearance of the skin was as if the hands were lacquered, and both hands felt cold and dry to the touch. This change extended as far as the wrists; the backs of the hands were slightly affected. The nails and the secretion of sweat were not affected. In the early stage of this affection there is a feeling of numbness and anasthesia; later the fingers become stiff and are the seat of a disagreeable feeling of tension. There is no itching or pain. The cause of this peculiar affection is believed to be metol, a sulphate of metyl-para-amidophenol, which is now largely used for developing negatives. The condition is similar to what has been described as local asphyxia of the skin, and Dr. Freund emphasizes the peculiar varnished-looking appearance of the skin, which is produced by contact with this substance. Recovery takes place spontaneously in two or three weeks, when the workmen abstain

from touching metal, the cure being hastened by the use of the ordinary ointments and plasters employed for an inflammatory condition of the skin.

ROENTGEN RAYS IN THE SOUDAN.—The daily press says that for the recent campaign two sets of Roentgen ray apparatus were provided. One of these, which was to be taken up the Nile by Major Battersby and be established at Abadi-eh. Considerable difficulty, and the greatest care had to be exercised to get the apparatus to the hospital in good order. At Korosko the temperature was between 115 deg. and 120 deg., but by dint of keeping the covers of the apparatus damp, it was got to its destination in good order, and, to the great relief of everybody concerned, was found to work well. Major Battersby has the assistance of Sergeant-Major Bruce, Royal Army Medical Corps, who has made himself an expert in the manipulation of the necessary complicated apparatus. This will be the main depot for Roentgen ray work, but Lieut. Huddleston, R.A.M.C., has taken a small outfit with 6-inch coil to the front.

At the request of the *Times*, Mr. John Le Couteur, the well-known expert, of 16, Brook Street, Grosvenor Square, left on Monday for Egypt, with the Roentgen ray apparatus, to meet Col. Rhodes, who is on his way from the Atbara to Cairo. Mr. Le Couteur will place his services primarily at the disposal of Col. Rhodes, and subsequently of others if required.

RADIOGRAPHY AND THE PHYSIOLOGY OF THE HEART.—M. Bouchard, at a recent meeting of the Academy of Sciences, reported some observations he had made upon the thoracic organs by means of the x-rays. Amongst other things he has been enabled to assert the existence of a marked dilatation of the auricles when the intra-thoracic blood-pressure is rais-

ed during inspiration. This condition is artificially brought about by endeavoring to inspire with the glottis shut, and is naturally brought about by the violent inspirations during a paroxysm of whooping-cough. M. Bouchard has also discovered that a clear horizontal space exists during forced inspiration between the shadow of the heart and that of the diaphragm, but during normal inspiration there is no space visible. This phenomenon, which is remarkable considering that the diaphragm and the pericardium are attached to one another, is explained by M. Bouchard in the following way. During the forced descent of the diaphragm in a large inspiration the inferior surface of the heart is in contact with the diaphragm to a very limited extent. The pericardium tucks itself into the space existing between itself and the heart, forming in front and behind a gutter into which in turn the pulmonary tissue is packed, thus forming a layer of tissue much more penetrable by the x-rays, than those which make up the heart and the diaphragm.—*Lancet*.

CONDENSER FOR INDUCTION COILS. Du-bois. *Wied. Ann.*, No. 65, page 86; abstracted, with some of the illustrations, in *Elek. Zeit.*, August 11.—He measured the secondary current with an electro-dynamometer, varying the resistance in the secondary circuit and the capacity of the condenser shutting the brake in the primary. Three of the six curves are reproduced in the abstract; one of them shows that a condenser of too great a capacity can reduce the current below the value which it would have without a condenser; he also showed that a condenser at the spark gap of a primary can increase the current appreciably even doubling it, but that the capacity of the condenser is determined by the resistance in the secondary circuit; with an increase of this resistance the capacity diminishes.

THE VALUE OF THE X-RAY IN MILITARY PRACTICE.

Extract From an Address, "Recent Experiences in Military Surgery After the Battle of Santiago," by Lieut. Col. N. Senn, M. D., U. S. V., Chief of Operating Staff With the Army in the Field.

The value of the probe as a diagnostic instrument in locating bullets has in modern military service been almost entirely superseded by dissection and the employment of the x-ray. If from the nature of the injury and the symptoms presented the bullet is located in a part of the body readily and safely accessible to the knife, and it is deemed advisable and expedient to remove it, this can often be done more expeditiously and with a greater degree of certainty by enlarging the track made by the bullet than by relying upon the probe in finding and on the forceps in extracting the bullet. If, as is often the case, the whereabouts of the bullet is not known, its presence and exact location can by the use of the x-ray be determined without any pain or any additional risks to the patient. All of the bullets removed on board of the hospital ship Relief were located in this manner. Dr. Gray, an expert in skiagraphy, who has charge of the scientific work of the floating hospital, has been of the greatest service to the surgeons in enabling them to locate bullets and in guiding them as to the advisability of undertaking an operation for their removal. His large collection of skiagraph pictures will also furnish a flood of new light on the effect of the small caliber bullet on the different bones of the body. Dr. Gray's work will constitute an essential and enduring cornerstone of a much-needed work on military surgery. The skiagraph has enabled us to diagnosticate the existence or absence of fractures in a number of doubtful cases in which we had to depend exclusively on this resource. In fractures in close proximity to large joints the x-ray has been of the greatest value in ascertaining whether

or not the fracture extended into the joint. In one case of gunshot wound at the base of the thigh, in which the bullet passed in the direction of the trochanteric portion of the femur, opinions were at variance concerning the extent of the injury to the bone; some of the surgeons made a diagnosis of fracture, while others contended that there was no fracture, but believed that the bullet had made a deep groove in the anterior portion of the bone and had possibly opened the capsule of the joint at the same time. The x-ray picture clearly demonstrated the absence of fracture and the existence of a deep furrow with numerous fragments on each side. The x-ray apparatus also proved of the greatest practical utility in showing the displacement of fragments in gunshot fractures of the long bones, and enabled the surgeons to resort to timely measures to prevent vicious union. The fluoroscope has greatly added to the practical value of skiagraphy. In the light of our recent experience the x-ray has become an indispensable diagnostic resource to the military surgeon in active service, and the suggestion that the chief surgeon of every army corps should be supplied with a portable apparatus and an expert to use it must be considered a timely and an urgent one.

X-RAYS. Smith. Lond. *Elec. Eng.*, July 29. *Electrical World*, N.Y.—A short article in which he claims that there is some connection between the materials used for the anodes and cathodes, and the material which is to be examined by means of the x-rays. Every element or combination gives a certain definite ray or tint; whatever this tint or ray when heated in the Bunsen burner, it will be the same when given off in the x-ray tube; the vapor ray given from flesh is yellow-green, and the yellow-green ray from the platinum must therefore pass through the flesh, but not the bone; if the ray

should penetrate the bone the anodes and cathodes should be made of compressed phosphate of lime or a clean piece of bone; if it is desired to see through steel the electrodes should be steel, brass for brass, etc. (It appears to be merely a suggestion, as no proofs are given.)

EVIDENCE THAT ROENTGEN RAYS ARE ORDINARY LIGHT. Stoney. *Phil. Mag.*, August. *Electrical World*, N. Y.—A short article supplying an omission in his paper in the June number of that magazine and giving the following summary of the results arrived at in that paper: "Roentgen rays consist of two distinct undulations, which present themselves in succession. They are an irregular progression of independent pulses in the first part of their course—from the target upon which the cathode rays impinge up to the object which is being skio-graphed. Beyond that object, between it and the fluorescent screen, they are a different undulation. For, as proved in the June number of the magazine, the radiation from the target is the same *physical* (and not merely kinematical) event as the simultaneous advance over the same ground of trains of waves, some of long, others of short wave lengths. Since the resolution into these trains of waves is physical the trains advance independently of one another; so that if, by any contrivance, some of them can be stopped, the rest will be unaffected and will proceed. Now the flesh of the human hand is a contrivance of this kind; it is opaque to the wave lengths of all visible light and of much ultra-violet light, but allows waves that are below a certain limit of shortness to pass through it. Accordingly the trains of sufficiently short wave lengths are the only physical constituents of the first undulation which can get past this obstacle; and are what produce, by their co-existence in the

space beyond, that second part of the Roentgen undulation which lies between the object and the fluorescent screen."

PROPERTIES OF THE VAPORS FROM THE CARBON ARC. Merritt and Stewart. *El'ty.*, September 7. *The Electrical World*, N. Y.—A brief abstract of an A. A. A. S. paper. They found that the vapors from an arc light behaved almost exactly like gases which have been acted on by x-rays, with respect to their power of discharging an electrified body, the only difference being that these gases retain their discharging power longer. When the vapors are drawn from the arc through a tube and caused to pass between a charged body and one which is grounded the former will gradually lose its charge, but the discharging current is not proportional to the voltage, as it increases less rapidly than the latter and approaches a limiting value. The discharging property is greatly increased if the vapor of water is introduced into the arc. The phenomena observed may be explained on the assumption that the air is ionized by passing through the arc—that is, the molecules of the air are to some extent torn apart so as to form positive and negative ions like in electrolysis. It is thought that the experiments probably have an important bearing on the theory of conduction in the electric arc.

RADIOGRAPH TUBES. Bonetti. *L'Ind. Elec.*, August 12. *Electrical World*, N. Y.—A very short Academy note. By varying the state of the gas in the interior of the bulb he succeeded in obtaining a lower resistance and thereby was enabled to use tubes which had become "hard" and were no longer of use. The method he used was to maintain a platinum wire at a red heat inside of the tube; the current was 2 to 3 amperes at 4 volts, and with this he obtained excellent results.

THE FALLACIES OF X-RAY PICTURES.

BY EDWARD A. TRACY, M. D., BOSTON.

Roengen's marvelous work on the properties of the x-rays (their nature is as yet unknown) has already been productive of much good in surgery and medicine—almost entirely in the field of diagnosis. The application of his discovery necessitates the rewriting of the text-books on fractures and dislocations. Facts, heretofore "smothered in surmise" are clearly set forth by the radiographs. For example, no writer, of which I am aware, on fractures, suspected the frequency, with which fracture of the ulnar styloid process accompanies Colles' fracture; yet this frequency has been demonstrated by radiographs of Colles' fracture.

While much has been gained in accuracy of diagnosis by the aid of x-ray pictures, there is one branch of practical medicine where harm is threatened by their employment. I refer to medical jurisprudence. X-ray pictures have been already admitted as evidence in some courts. Their indiscriminate admission will hurt the cause of justice—because they can easily lead to fallacy or error. Their use as evidence of injury, is only safe when certain conditions have been fulfilled, in their taking and presentation. I shall briefly indicate further on what these conditions are.

In all x-ray pictures there is distortion. The reason is x-rays emanate from a point, and are not parallel. Interference with these rays follow the ordinary physical and mathematical laws of rays emanating from a point. (Of course it is understood that there is neither reflection nor refraction of the x-ray.) Thus the nearer to the source is an obstruction to the rays, the larger will be the resultant shadow or picture; the size of the shadow depends also upon the nearness of the object to the surface upon which the shadow falls; the

further the surface from the object, the larger the shadow. If we had for a source of x-rays a surface as large as the object to be pictured, there would be no distortion, for the x-rays would be parallel. X-ray pictures in that case would be easy of comprehension and never misleading. To read correctly the lesson of an x-ray picture, the obliqueness of x-rays must be kept in mind, and mental correction made for the disproportion and distortion caused by this obliqueness.—*Journal of Electro-Therapeutics*.

Distortion of the picture, in fluoroscopic examinations, caused by divergence of the x-rays can be easily corrected with mathematical certainty by the Dennis fluorometer.—ED.

REMOVAL OF A BULLET FROM THE BODY OF THE AXIS AFTER ITS LOCALIZATION BY SKIAGRAPHY.—In the *Intercolonial Medical Journal of Australasia*, Dr. E. Bird has published a case of this novel operation, which certainly could never have been carried out without the aid of skiagraphy. The operation was performed more than three months after the injury, at the earnest solicitation of the patient, who suffered a good deal from deep cervical pains on the left side and stiffness of the neck. A three inch incision was made along the posterior border of the sternomastoid muscle in order to gain access to the lateral aspect of the second and third cervical vertebra. The dissection was continued until the descending fibers of the first bundle of the levator anguli scapula were well defined in their upper two inches. The great vessels and nerves were held forward and search made for the bullet. It could be neither seen nor felt, but the transverse process of the axis was in advance of the next. On holding the pharynx forward the dark bullet was seen buried in the body of the axis. Bone had to be snipped away before it could be extracted; re-

covery followed.—*Journal of the American Medical Association.*

Western Surgical and Gynecological Association.

The eighth annual meeting of the Western Surgical and Gynecological Association will be held at Omaha December 28 and 29, 1898. Titles of papers from some of the leading surgeons of the west are already in the hands of the secretary and the coming meeting promises to be the most interesting yet held. The local committee of arrangements at Omaha is actively preparing for the entertainment and comfort of those who attend. Surgeons and gynecologists, and those interested in the progress of these specialties, are cordially invited to affiliate themselves with us. The secretary will be glad to send application blanks. Titles of papers should be sent to the secretary as soon as possible, but not later than November 20, to insure a place on the program.

GEO. H. SIMMONS, Secretary,
Lincoln, Neb.

D. S. FAIRCHILD, President,
Clinton, Ia.

COLORED PHOTOGRAPHS BY ACTINO ELECTRICITY. Delvallez. *L'Eclairage Elec.*, August 13. *The Electrical World.*—A short Academy note describing the following process: If a plate of brass forming a parasitic electrode is immersed in a mixture of the acetate of copper and lead and a current be passed through the liquid colored images will be produced, due to the deposition of the peroxide of lead; if different points of a plate of brass are unequally illuminated, local currents will circulate in the liquid, the circuits of which are closed through the plate; these currents produce electrolysis—that is, will deposit peroxide of lead at certain parts and those points which are equally illuminated will have identical colors; the colors vary with

the amount of illumination. Experiments verified this deduction. The deposits observed were not caused by differences of temperature.

LUPUS TREATED WITH THE ROENTGEN RAY AND HOT AIR.—E. Schiff reports two children with lupus completely cured to date by the application of the Roentgen ray, and Lang has also had similar success with the Hollander apparatus, a coiled metal tube connected with a Bunsen burner, from which a stream of hot air at a temperature of 228 degrees C. at a meter's distance was directed upon the patches. The scab and blister formed were only superficial, and the resulting cicatrization proved much smoother and more esthetic than after any other process.—*Munch. Med. Woch.*

CATHODE RAYS. Merritt. *Elty.*, September 7. *The Electric World.*, N. Y.—A brief abstract of an A. A. A. S. paper on the magnetic deflection of diffusely reflected cathode rays. He measured the deflection of the so-called para-cathodic rays in a given magnetic field and compared it with the magnetic deflection of the direct cathode rays in the same tube, but could detect no difference in the behavior of these two sets of rays. He is therefore of the opinion that the para-cathodic rays are really the same as cathode rays, and result from diffuse reflection.

RADIOGRAPHS OF ENCAPSULATED TRICHINA.—Radiographs of encapsulated trichina in the muscle of a cadaver have been secured at Wurzburg, the birth-place of the Roentgen ray.

CATHODE RAYS. Villard. *L'Eclairage Elec.*, August 6. *The Electrical World.*—A reprint of an Academy paper on the emission and propagation of these rays.

**INDIVIDUAL IDENTIFICATION SHOWN
BY THE X-RAYS.**

BY DOCTOR FOVEAU DE COURMELLES,

Laureate of the Academy of Medicine; Vice-President of
the Society of Hygiene of France, etc.Translated from the French by L. S. Newman, M. D.,
St. Louis, Mo., for THE AMERICAN X-RAY JOURNAL.

The differences in transparency, even in opaque bodies, made apparent by the use of the Roentgen rays permit us to note important and useful differences of appearance as well as certain points of resemblance, thus allowing us to make certain standards for comparison. For the same Crookes' tube operating under similar conditions at two different times there will be differences in intensity, which it will not do to interpret as real in the examination of objects submitted to the radiations.

But, with these exceptions, it has been demonstrated that the capacities of different subjects vary greatly according to the age and structure of their osseous systems.

These are very important elements from a medico-legal standpoint. The age of the subject notably showing the tissues in process of formation is easily differentiated in the first twenty years of life, as the bones are not yet completely formed and present solutions of continuity allowing of an easy diagnosis. We can thus draw average standards by taking them from series of radiographic pictures taken at different ages.

The bearing of the application of the x-rays in estimating the gravity, the importance and the prognosis in fractures is also very great.

Eighteen months ago I was given an opportunity to examine a roofer, who, during the course of his labors had sustained injury. It was at this time that Roentgen's discovery was first made use of in the courts of France. The fibula had been broken and the fracture had

been well reduced, but the subject complained of pain and weakness in walking, which, he claimed, prevented him from climbing upon roofs and carrying the materials used in his business.

If he was examined he cried out with pain, but if his attention was detracted, it was easy to make out a well formed callus and the patient said nothing. For this reason he was thought to be simulating. We submitted him to the x-rays and were then able to judge of the importance, to him, of the fracture, which undoubtedly constituted a partial disability on account of the character of the patient's occupation, in which the slightest mis-step might reproduce the fracture. The medico-legal importance of this fact from the particular point of view for which I was consulted naturally leads to a process of research in connection with the identification of individuals.

Knowing of the existence of a fracture in a person, who has been burned or mutilated beyond recognition, we can hope to identify him by the x-ray and conclude therefrom that a member found really belongs to the person supposed to have disappeared.

In the accident of the Bazar de la Charite, of May 4, 1897, at Paris, it would have been possible in certain doubtful cases to utilize this method, and deduct from certain callus formations then mapped out, the identity of the missing party, understanding of course that we know of the existence of certain bony lesions, even though as old as ten years.

In the case of criminals it might be possible to connect the complete skeletal description of the parties under arrest to the anthropometric examination; although it is true that it would be long and expensive and for this reason its application is not likely to occur soon.

Certain congenital luxations, visible it

is true by the immobility and loss of function, might be examined in this way with a view towards making a prognosis.

During the maneuvers of obstetric operations the traction practiced might cause a scapulo-humeral or a coracoclavicular disarticulation, which is difficult to map out and for which the surgeon would require radiography and thus easily and immediately show the lesions.

ACUTE INFLAMMATION OF THE PROSTATE GLAND.—*The Journal of the American Medical Association*, for August 20th, contains a report on inflammation of the prostate gland, which was presented to the Section on Surgery and Anatomy at the Forty-ninth Annual Meeting of the American Medical Association, held at Denver, Colo., June 7-10, 1898, by Liston Homer Montgomery, M.D., of Chicago, Ill. His plan of treatment in acute inflammation of the prostate gland is to wash out the abscess cavity with hydrogen peroxide, give copious hot water enema and hot hip baths frequently, avoid morphine internally and advise care lest the patient strain at stool or during micturition. On the theory that toxins are retained in the circulation and within the gland, and to prevent degeneration in the gland substance, he administers triticum repens or fluid extract tritipalm freely, combined with gum arabic or flaxseed infusion. Along with these remedies the mineral waters, particularly vichy with citrate of potash, go well together. Hydrate of chloral or this salt combined with antikamnia are the very best anodyne remedies to control pain and spasms of the neck of the bladder. These pharmacologic or medicinal remedies are the most logical to use in his judgment, while externally, applications of an inunction of 10 or 20 per cent iodoform, lanoline, as well as of mercury, are also of value.

CURIOUS REVERSED ACTION IN A TUBE.

BY ERNEST PAYNE.

While experimenting with a tube a month or two ago, I noticed a curious effect, as if the action of the tube were in some way reversed, the current remaining in the same direction. I had connected a sheet of tin foil (mounted on a glass plate) to the cathode terminal, to see whether it would have any effect on the action of the tube by retarding, as it were, the arrival of the charge on the cathode side, and having an effect analogous to a condenser. When first started, the light and shade in the tube were reversed, x-rays were given off behind the cathode and from the back of the anode, causing the usual green fluorescence; the part usually illuminated remained dark, and no rays could be detected by the screen. The rays from the back of the anode were strong, and the bones of the hand were visible on the screen, while those from the back of the cathode were much feebler, although strong enough to show fluorescence two feet away and a shadow of the hand, but not to distinguish the bones.

The tube ran like this for about half a minute, and then suddenly reversed to its normal mode of action. I again tried it, without the sheet of tin foil, and the same reversed effect was produced; but it only lasted a few seconds, and then ran in the usual way.

I could not account in any way for this action, as the tube had been working the day before in the usual manner. The anode of the tube was composed of a disc of aluminum, with a thin plate of platinum attached to it, and with the usual form of cathode. The effect seems to show the very unstable condition of things prevailing in a tube when in action.—*Archives of The Roentgen Rays.*

RADIOGRAPHY IN COXALGIA, ESPECIALLY IN ITS BEGINNING. Congress of Science of Nantes, August 4 to 12, 1898. M. Redard.—Radiography renders valuable service in the study of alterations of the articulation of the hip, which are accessible with difficulty to clinical exploration because of their depth, and the thick muscular masses that cover them. It is particularly at the beginning of coxalgia that this method of investigation permits certain diagnosis, and, inversely to establish the fact of the integrity of the joint in false coxalgia. As respects treatment, radiography furnishes also valuable indications, by making it possible to recognize the exact seat of articular or osseous lesions, to determine displacements, deformities of the femoral head and the pelvis, the presence of sequestra or of purulent collections and periarticular modifications and changes. —*The Medical Times*, N. Y.

DR. WM. M. GRAY, the microscopist of the Medical Museum at Washington, was detailed by that institution for surgical work in the war, with special reference to the diagnosis of gunshot wounds by the Roentgen rays. In giving the results of his observations Dr. Gray says:

"One thing this war has taught is that the probe in all its forms has gone out of use. No more searching blindly in a man's body for the bullet; no more danger of blood poisoning from the introduction into the wound of instruments of search. The fluoroscope tells us instantly where the projectile has imbedded itself, and we have only to cut it out as if it were there before our eyes. The ingenious electric probe and all similar devices have seen their day. In all future battles experts in skiagraphy will be attached of necessity to the Medical Corps, and the work of the surgeons will be materially assisted by their precise indications. We took out bullets by the

pint on board the Relief, and almost without exception they were located by the x-rays.

"It is all done in a few moments; five seconds for a wound in the hand, thirty seconds for one in the foot, and not over ten or fifteen minutes for a wound through the thick pelvis. The patient is stretched out on a table, the x-ray bulb adjusted over the wound, the plate put under the limb or part where the wound is, and the thing is done. The plates are developed almost instantly. In many cases we save hours of vain searching; not infrequently we save the soldier's life."

AIR UNDER POWERFUL ELECTRIC STRESS. Trowbridge. *Phil. Mag.*, August. *Electrical World*, N. Y.—A short article on the behavior of air and rarefied gases under powerful electric stress. He lately increased the number of his condensers to 120, thus obtaining an E. M. F. of 3,000,000 volts. The initial resistance of air under these circumstances is greatly reduced, and the curve representing the relation between spark length and voltage departs from a straight line beyond 1,200,000 volts, approaching the axis expressing the voltage; thus the extreme length of spark in air with 3,000,000 volts is 6.5 feet, whereas it should be 10 feet if the proportionality between spark length and voltage had been maintained. This departure from proportionality is due to the increased conducting power of air; a powerful brush discharge passes to the floor and walls; portions of the discharge are shunted through the surrounding air; with still higher voltages it is probable that the resistance of air would be of the order of metals. The initial resistance also of highly rarefied media diminishes in a similar way; thus a Crookes tube which resisted the passage of an 8-inch spark is brilliantly lighted by 3,000,000 volts; one discharge lasting a millionth of a

second is sufficient to obtain a photograph of the bones of the hand. The electrostatic field in the neighborhood of the apparatus is extremely powerful; long sparks can be drawn from neighboring metallic masses. The behavior of air and rarefied gases with powerful electric stress is analogous to that of elastic bodies under mechanical stresses; the initial resistance of air steadily diminishes with powerful electric stresses, and under disruptive discharges sinks to 2 or 3 ohms; this leads to a rapid change of potential producing the electro-magnetic impulses, which we have reason to believe, are the source of the x-rays.

RADIOGRAPH SHOWING AN OSTEITIC AREA. *Medical Review of Reviews.*—Dr. Myers exhibited a radiograph which showed an area of diminished density within the head of the radius and increased density about it. A sclerosing osteitis probably surrounded the site of a caseous focus which had been curetted. After many trials this was the first success he had made in locating a diseased area by the x-ray.

RADIOGRAPHY in Dental Surgery has been much improved by the use of the radio condenser (*Jour. of the Am. Med. Ass.*, xxx, 988) and "metallic rubber." Some interesting radiographs were recently presented at the Paris Acad. de Med., among them some that showed the fully-developed canines buried deep in the palatine arch, with no possibility of eruption.

Instructive Exhibits.

"One of the chief attractions at the annual gatherings of The American Medical Association is always the exhibition hall, where the principal drug, instrument and food products of the world, the results of years of experimental research and labor, are placed in view."

"Among the many attractive exhibits at this year's Denver meeting, that of Imperial Granum, recognized by many

leading physicians as the standard among prepared foods, occupied a prominent space and the representative in charge was kept busy explaining to the visiting physicians the superiority of this preparation. Handsome sample boxes of the Food, and copies of The Imperial Granum Co.'s valuable clinical record, were presented to each physician in attendance."—From *The Journal of The American Medical Association*, Chicago.

Rheumatism.

There are many cases of rheumatism in its various forms, which otherwise prove most obstinate and unyielding, but which can be corrected speedily and thoroughly by the use of Tongaline Liquid or Tongaline Tablets or Tongaline and Lithia Tablets or Tongaline and Quinine Tablets, as the conditions may indicate, all to be taken at short intervals and washed down with plenty of hot water, as hot as the patient can bear it.

This treatment may be supplemented by the local application of Tongaline Liquid; or what is a very important fact the disturbing effects of internal medication upon an irritable stomach and sensitive nerves can be entirely avoided by the external use of Tongaline Liquid alone.

The affected parts should be sponged first with hot water, then with Tongaline Liquid, and cloths saturated with the remedy held in apposition by oiled silk bandages, applying heat by a hot water bag or other convenient method to facilitate absorption. Tongaline Liquid, in like manner, may be given externally by the aid of electricity.

FOR ACUTE CYSTITIS.—Bromide of Potash oz. $\frac{1}{2}$; fld. ext. gelsemin. gtt. 10; fld. ext. hyoscyam. dr. 2; lithiated hydrangea (Lambert), q. s. ad oz. 4. Mix. A dessert spoonful every four hours. Milk and flax seed tea as drinks.—*Kansas Medical Index.*